Spatial Data Standard
for facilities, infrastructure, & environment
(SDSFIE)

and

Facility Management Standard
for facilities, infrastructure, & environment
(FMSFIE)

Data Model and Structure

(Updated for the SDSFIE/FMSFIE Release 2.00, January 2001)

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Note:

The names and acronyms for the Geographic Information System (GIS) and Facility Management (FM) standards developed by the CADD/GIS Technology Center have changed over the years. The name and acronym changes were directed by the CADD/GIS Technology Center oversight organizations (i.e., Standards Working Group, Corporate Staff, & Board of Directors) as a result of broader goals and objectives and the incorporation of Federal Government organizations beyond the Department of Defense (DoD).

Prior to July 1999 the standards were called the "Tri-Service Spatial Data Standards" (TSSDS) and "Tri-Service Facility Management Standards" (TSFMS) (i.e., Releases 1.40 - 1.80). The names/acronyms "Spatial Data Standards" (SDS) and "Facility Management Standards" (FMS) were used from July 1999 until January 2001 (i.e., Releases 1.90 & 1.95). The names/acronyms have been changed to "Spatial Data Standard for Facilities, Infrastructure, and Environment" (SDSFIE) and "Facility Management Standard for Facilities, Infrastructure, and Environment (FMSFIE) in January 2001 (i.e., Release 2.00).

SDSFIE Data Model and Structure

Introduction

The facilities installation and civil works communities within the Department of Defense (DoD) and other Federal Government organizations utilize a number of computer-based systems for the capture, storage, retrieval, display, and analysis of geospatial and "business" information. These systems fall within the general categories of Geographic Information Systems (GIS), Computer-Aided Design and Drafting (CADD) Systems, and Facility Management (FM) Systems, but may also be called by other names including Emergency Information Systems (EIS) or Land Information Systems (LIS). Fundamentally, all of these systems store and display information that have some geospatial or locational significance to the user. However, the default data structure and specific capabilities of the various systems can vary significantly.

Each of these systems store and reference spatial data in fundamentally different ways, to achieve differing objectives. CADD systems are intended for the analysis, design, drawing, and display of engineering graphic applications, whereas GIS systems are geared more towards display and spatial analyses of both graphic and non-graphic data from multiple disciplines. Even within the same category, there are tremendous variations in data structures utilized by the various software vendors.

This variability in data structure makes the development of an universally acceptable data dictionary very difficult. Users tend to model spatial data in the same structural order as that employed by the software system which they most frequently use. A data dictionary developed using terminology and data structure employed by Intergraph's Modular GIS Environment (MGE) may not make sense to an ESRI Arc Info user. However, there are certain terms which have widespread understanding and acceptance. Likewise, there are general data structures utilized by the spatial data software most commonly employed by facilities, installations, and civil works organizations. Many organizations are using CADD and AM/FM systems for mapping instead of a GIS. However, this situation is changing rapidly in favor of a GIS system.

The SDSFIE/FMSFIE employ terminology and data structures not specific to any software product. Provisions for raster and vector data and CADD, GIS, and AM/FM systems have been made to accommodate the widest user base in the Tri-Services community. Some interpretation will be required on the part of all users, regardless of the system which they currently use. Differentiation between these systems is becoming increasingly obscure, as software developers add new features and capabilities to their systems. Fully integrated raster, vector, and CADD systems are now available. Each system has some advantage, and this standard attempts to make provisions for use by all of them.

While the SDSFIE/FMSFIE are intended to be data specific rather than application specific, certain elements within the standard is constrained to conform to the lowest common capability of applications most widely used by the facilities, installations, and civil works communities within DoD (here after referred to as DoD facilities). This consideration makes this release of the SDSFIE different in both format and content from earlier version of the standard. There is no guarantee, however, that all of the constraints applicable to a given software application have been adequately addressed. The user may still require judgement with respect to how the given data structures defined in this standard will be applied.

Given the great diversity of computer-based spatial data systems in use within the DoD facilities community, constructing a single reference document that is universally applicable is difficult. This document has adopted terminology that is commonly understood and not singular to any one system. To the larger extent, the terminology is consistent with the Federal Geographic Data Committees' definitions and the Spatial Data Transfer Standard. As such, it is not explicitly applicable to an Arc Info user, or an MGE user, or an AutoCAD user. Some interpretation will be required on the part of all users, regardless of the system they currently use.

The Spatial Data Standard represent an organization of data without regard to application. The assignment of specific entities to entity sets is a function of data maintenance rather than data use. In this way, it is possible to more easily reduce the redundancy of information within the standard. This schema will meet data sharing requirements of the National Spatial Data Infrastructure (NSDI).

The preponderance of existing DoD facilities-based GIS use either Intergraph MGE or Arc Info application software. The majority of FM functions in the DoD facilities community use Bentley's MicroStation or AutoDesk's AutoCAD with an attached database. The Spatial Data Standard physical data model was designed to support these CADD and GIS software products. Presently, the physical data model also meets the database requirements of Oracle (Oracle Corporation), Informix (Informix Software, Inc.), Access (Microsoft), and SQL Server (Microsoft). The model meets the operating system requirements for DOS, UNIX, Windows 95/98, and Windows NT.

Presentation Graphics

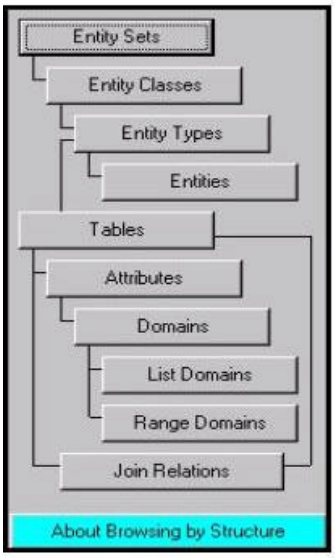
Specific symbologies for graphic elements are defined in the SDSFIE. These line styles/types, thicknesses/width, colors, and graphic symbols are included to assist with the standardization of map product display. It must be remembered, however, that output production for GIS is designed to relate the maximum amount of information. In many cases, adjusting these graphic properties helps

the reviewer more easily decipher the graphic information. Accordingly, maximum flexibility in these assignments is encouraged

Integrated Definition Models

Integrated Definition (IDEF) is the name given to a family of over 30 graphical modeling techniques. The $IDEF_o$ and $IDEF_{1x}$ are the best known of these techniques. $IDEF_o$ techniques are used to describe business processes or activities for reengineering a function. $IDEF_{1x}$ techniques are used to define business rules and create a logical data model. The DoD data standardization policy states that all new initiatives to develop or modernize an information system must be based on an $IDEF_{1x}$ data model. $IDEF_{1x}$, FIPS 184, provide a model that represents the structure and semantics of information within an environment. It supports integration through a conceptual schema independent of specific applications and physical implementation. Once the $IDEF_{1x}$ logical data model is completed, a physical data model such as the Spatial Data Standard, is developed for physical implementation on specific application software. $IDEF_{1x}$ data models are developed and available for each new release of the SDSFIE and FMSFIE in both an Erwin EX (.er1) digital format and Acrobat Reader (.pdf) digital format.

Size and Complexity -
SDSFIE/SDSFIE Release 2.000



26	Entity Sets
181	Entity Classes
1,006	Entity Types
5,453	Entities (CADD & CADD Based GIS)
1,014	Attribute Tables (Database Tables)
25,844	Attributes (Fields in Tables)
959	Domain Tables (List & Range)
21,542	List Domain Values
18	Range Domains
8,149	Relational Database Join Relationships

SPATIAL DATA STANDARD DATA MODEL

Both graphic (i.e., symbols, text fonts, line styles/types, and level/layer schemas) and nongraphic (e.g., database attribute tables and domains) geospatial data requirements are addressed in the SDSFIE. As depicted graphically in the above figure, the SDSFIE data model consists of five basic levels of hierarchy: Entity Sets, Entity Classes, Entity Types (includes Entities), Attribute Tables, and Domain Tables. The different CADD and GIS software vendors use different names for the levels of hierarchy or grouping of geographical features or entities. The following paragraphs include a comparison of MGE, Arc Info, MicroStation, AutoCAD, and the SDSFIE/FMSFIE terminology.

The CADD/GIS Technology Center provides annual updates of the SDSFIE. Currently (i.e., Release 2.00), the SDSFIE is maintained in a Microsoft Access 97 database. The data dictionary for the SDSFIE and FMSFIE Maintenance Database is provided in Appendix A.

Entity Set. *Entity Sets* are the highest level of the SDSFIE data model structure and represent data organized at the project level. *Entity Sets* are broad, generalized themes containing groupings (called Entity Classes) of features (i.e., graphic objects (called Entity Types) which can be depicted at their actual geographic locations on a map) and related "graphic" attribute data (i.e., data (information) about the feature which is stored in a database table). The SDSFIE Release 2.00 structure contains the following twenty-six Entity Sets: (1) Auditory, (2) Boundary, (3) Buildings, (4) Cadastre, (5) Climate, (6) Common, (7) Communications, (8) Cultural, (9) Demographics, (10) Environmental Hazards, (11) Ecology, (12) Fauna, (13) Flora, (14) Future Projects, (15) Geodesy, (16) Geology, (17) Hydrography, (18) Improvements, (19) Landform, (20) Land Status, (21) Military Operations, (22) Olfactory, (23) Soil, (24) Transportation, (25) Utilities, (26) and Visual.

The appropriate *Entity Set* name is reflected in the first two characters of each attribute table name code.

For CADD (e.g., MicroStation and AutoCAD) and CADD-based GIS (e.g., MGE, AutoDesk Map, and Bentley GeoGraphics), the Entity Set name is also represented in the first two characters of each design file name code.

EXAMPLE: The first two characters of each attribute table name code in the *TRANSPORTATION* Entity Set is always represented by "tr".

A complete listing of the two character *Entity Set* abbreviations (for Release 2.00) is depicted in the following table:

Auditory	au	Fauna	fa	Soil	so
Boundary	bd	Flora	fl	Transportation	tr
Buildings	bg	Future projects	fp	Utilities	ut
Cadastre	cd	Geodetic	gd	Visual	vs
Climate	cl	Geology	ge		
Common	cm	Hydrography	hy		
Communications	co	Improvement	im		
Cultural	cr	Land status	ls		
Demographics	de	Landform	lf		
Ecology	ec	Military operations	ml		
Environmental Hazards	eh	Olfactory	ol		

Entity Class. *Entity Classes* comprise the next level of the hierarchical SDSFIE data model structure. *Entity Classes* contain groupings of similar features (called Entity Types) and related "graphic" attribute data. Each Entity Class is equivalent to a separate map or drawing file. Equivalent names used by various CADD and GIS software vendors are provided in the following table:

CADD/GIS Software (Vendor)	**Counterpart Name for Entity Class**
MGE (Intergraph)	Category or Design file
ARCINFO (ESRI)	Workspace
MicroStation (Bentley)	Design file
AutoCAD (AutoDesk)	Drawing File

The name of *Entity Class* is represented by a three character code which makes up a part of the attribute table name codes (and design/drawing files name codes for CADD and CADD-based GIS).

EXAMPLE: Each attribute table name in the ***transportation_vehicle*** *Entity Class* begins with "***trveh"***, where ***"tr"*** represents the *Entity Set* name and ***"veh"*** represents the *Entity Class* name.

A complete listing of the three character *Entity Class* abbreviations (for Release 2.00) is included in Appendix B.

The SDSFIE is designed to be CADD and GIS software platform independent, which means the standard is designed to work with the most limiting of the commercially available CADD and GIS software platforms. This SDSFIE design criteria determines the number of *Entity Types* to be included within each *Entity Class*. In this case, MicroStation (and MicroStation based GIS software), which

accepts up to 63 CADD layers per design file (i.e, an *Entity Class*), is the limiting factor.

Entity Type. Each *Entity Class* contains one or more *Entity Types.* An *Entity Type* is the logical name assigned to a graphic feature (i.e., an object that can be graphically depicted on a map or drawing). Each *Entity Type* has a corresponding "graphic" attribute table containing specific information about the *Entity Type*.

An *Entity Type* is equivalent to a "coverage" in ArcInfo and a "view" in ESRI ArcView. *Entity Types* in MGE are grouped by features.

For CADD (e.g., MicroStation and AutoCAD) and CADD-based GIS (e.g., AutoDesk Map and Bentley GeoGraphics) software, *Entity Types* represent a grouping of like cartographic (or CADD) elements (called *Entities*) assigned to separate levels/layers.

*Discriminators***.** Effective use of GIS relies on the ability of the user to adequately differentiate subtle differences in geographical features, or *Entities*. This differentiation permits greater value in output products by selectively displaying *Entities* based on some pre-defined criteria. While some differentiation is determined by the assignment of the graphical properties (color, for example), it is often useful to expand the capability of this differentiation to only display selected *Entities* (i.e., displaying a map of only the paved roads).

Historically, the CADD user has accomplished this differentiation by assigning these different *Entities* to different layers or levels within the drawing file. Virtually all CADD systems provide a simple capability to turn various layers on or off to allow for the display of only selected entities. This technique allows the user to "discriminate" these *Entity Types* on the basis of the layer or level. The user must understand that paved roads are to be placed on a different level from unpaved roads.

Other GIS applications, including ArcInfo, do not store data with level/layer assignments, but rather organize graphic entities based on a specific *Entity Type* (road) with a "discriminator" included as a part of the attached attribute data (paved or unpaved). This allows the display of all roads without having to access multiple drawing files. This additional differentiation using the attribute data has been included in this version of the SDSFIE, to allow for differentiation of these *Entity Types* using layer/level or tabular attribute, or even both if desired.

The individual features are logically grouped into *Entity Types* with the inclusion of a discriminator field in the corresponding attribute data. Because this discriminator has only discrete values, it is defined with respect to a domain table, which defines the values which discriminate the *Entities*. Continuing with the previous example, the attribute table associated with Entity Type roads (trvehrd) now contains an attribute which defines the paved status of the road (paved_d)

which refers to the domain table (d_pavstt) which contains the values "PAVED" and "UNPAVED". A user or developer can now select the roads which have the paving characteristics desired, or ignore the discriminator completely and display all roads. The technique allows for maximum flexibility in displaying only the information desired to convey the maximum amount of information.

Within the standard, the inclusion of the discriminator concept requires the addition of another *Entity* category. This additional category or grouping of *Entities* is defined as *Entity Types* which consist of a given graphic feature "road". These *Entity Types* are normally included in the standard as nouns, while the discriminators represent adjectives which further define or describe these nouns. This modification significantly changes the format of this release of the standard.

GIS Features and Target Map Scales. A GIS feature can be depicted as one of the following three primitive geometrical graphical elements:

a. *Boundary (G/GT Polygon)* - A line string (or group of arcs) which forms the perimeter of an area. An example would be the boundary of a lake. The Federal Information Processing Standards Publication (FIPS) Publication 173, entitled "Spatial Data Transfer Standard (SDTS)", provides the following definitions:

"*G-Polygon (PG)* - An area consisting of an interior area, one outer G-ring and zero or more nonintersecting, nonnested inner G-rings. No ring, inner or outer, shall be collinear with or intersect any other ring of the same G-polygon."

"*GT-Polygon (PR, PC)* - An area that is an atomic two-dimensional component of one and only one two-dimensional manifold. The boundary of a GT-polygon may be defined as GT-rings created fromits bounding chains (either the bounding set, or the complete set) by direct reference to these chains. The complete set of chains associated with a GT-polygon may also be found by examining the polygon references on the chains."

b. *Point* - A single point representing the geographical location of a feature; e.g., a well or power pole. Points are normally represented on a map by a symbol. The SDSFIE provide symbols sets in native AutoCAD, MicroStation, and ArcInfo digital formats. FIPS Publication 173 provides the following definitions for a point:

"Point (NP) - A zero-dimensional object that specifies geometric location. One coordinate pair or triplet specifies the location."

"Entity point (NE) - A point used for identifying the location of point features (or areal features collapsed to a point), such as towers, buoys, buildings, places, etc."

c. *String/Chain* - A line or group of arcs. An example would be a road centerline. FIPS Publication 173 provides the following definitions for a string/chain:

"String (LS) - A connected nonbranching sequence of line segments specified as the ordered sequence of points between those line segments. Note: A string may intersect itself or other strings."

"Chain - A directed nonbranching sequence of nonintersecting line segments and (or) arcs bounded by nodes, not necessarily distinct, at each end."

There are two general categories of target map plot scales:

a. *Small Scale Maps* - This category includes maps with plotted map scales of 1:62,500 or 1 inch = 5208 feet or smaller. A USGS quadrangle map would be an example of a small scale map.

b. *Large Scale Maps* - This category includes maps or drawings with plotted map scales greater than 1 inch = 5,208 feet. Municipal, utility, master plans, base comprehensive plans, construction drawings are examples of a large scale map.

The SDSFIE permits the capability to depict GIS features (*Entity Types*) as a different geometrical graphical element at different target map plot scales. For example: An Environmental Restoration Site (e.g., a DoD Installation Restoration Program (IRP) Site) which would be depicted as a "point" type graphical element (with a symbol) on a small scale map (e.g., USGS map with a plotted scale of 1 inch = 5,280 feet) would be depicted as a "boundary" type graphical element on a large scale map (e.g., map with a plotted scale of 1 inch = 100 feet).

The term "site" is used in the names of the SDSFIE Entity Types which may be displayed as either a Point or a Polygon, depending on the target map plot scale.

Entity. As previously mentioned, entities are individual graphic elements which represent a feature (*Entity Type*). These are assigned depending on the object type of the parent *Entity Type* (G/GT Polygon, Point, or String/Chain) and are described as Boundary, Centroid, Label, Text, Point, and Line object types. The collection of all *Entities* within an *Entity Type* graphically display and represent the feature (*Entity Type*).

The *Entity Name* and *Feature Type* code end in a letter designating the feature types as noted below. These object types include:

Boundary - The line string which forms the perimeter of an area. A boundary feature would be depicted on a map or drawing with the specific SDSFIE defined Line Style. (Coded as a "b" for feature type).

Centroid - An electronic point within the boundary to which the attribute table is attached. (Coded as a "c" for feature type).

Label - The placement and position of a displayable attribute within the attached attribute table. (Coded as a "a" for feature type).

Text - Any annotation relating to the *Entity* or which more adequately convey information about the map product. (Coded as a "t" for feature type).

Point - A single point representing the geographical location of a feature. A point may be displayed as a raster or vector Symbol (see SDSFIE Symbol Sets). (Coded as a "p" for feature type).

String/Chain - A collection of vertices which, when taken as a whole, represent a line string on the map. While some CADD/GIS software provide the capability to give the line segments mathematically formula, the SDSFIE assumes that the connection between vertices is always represented as a straight line. The line segments may have a pattern (SDSFIE defined Line Style) which gives the map element additional meaning to the viewer. (Coded as a "l" for feature type).

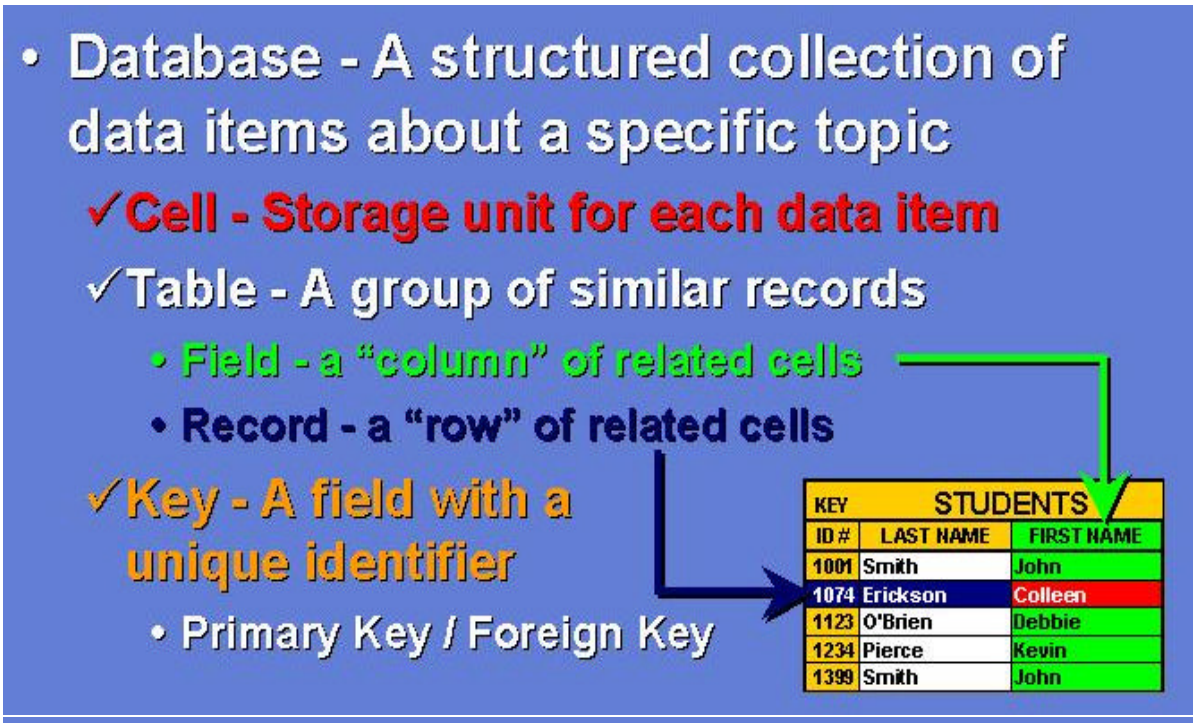
A decision should be made whether or not survey, mapping, or digital geospatial data will later be used for both CADD and GIS applications. Many organizations prepare digital survey maps and drawings using CADD software (e.g., MicroStation and AutoCAD), even when these maps and drawings are to be incorporated at a later date into a GIS. The portions of the SDSFIE pertaining to CADD symbology and naming conventions (i.e., colors (applicable to all features), line styles (applicable to boundaries and string/chains), symbols (applicable to points), level/layer assignments (applicable to all features), drawing file naming conventions (applicable to all features), and fonts (applicable to text)) should be followed in the development of these CADD maps and drawings.

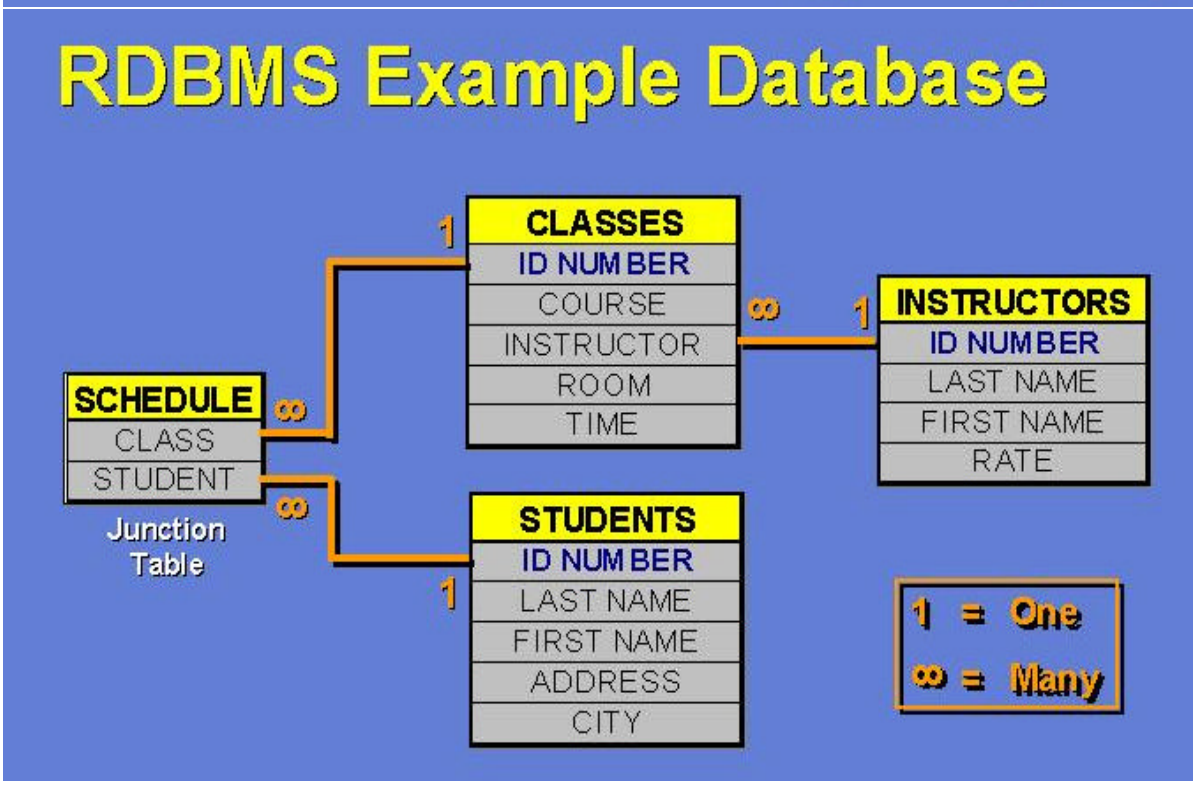
SDSFIE Attribute Table. A SDSFIE *Attribute Table* is a relational database table containing data, or information, about a specific SDSFIE entity. Since SDSFIE *Attribute Tables* are linked directly to a graphic entity (using the electronic tools provided with CADD and GIS software) they are classified as “graphic” (i.e., SDSFIE) attribute tables.

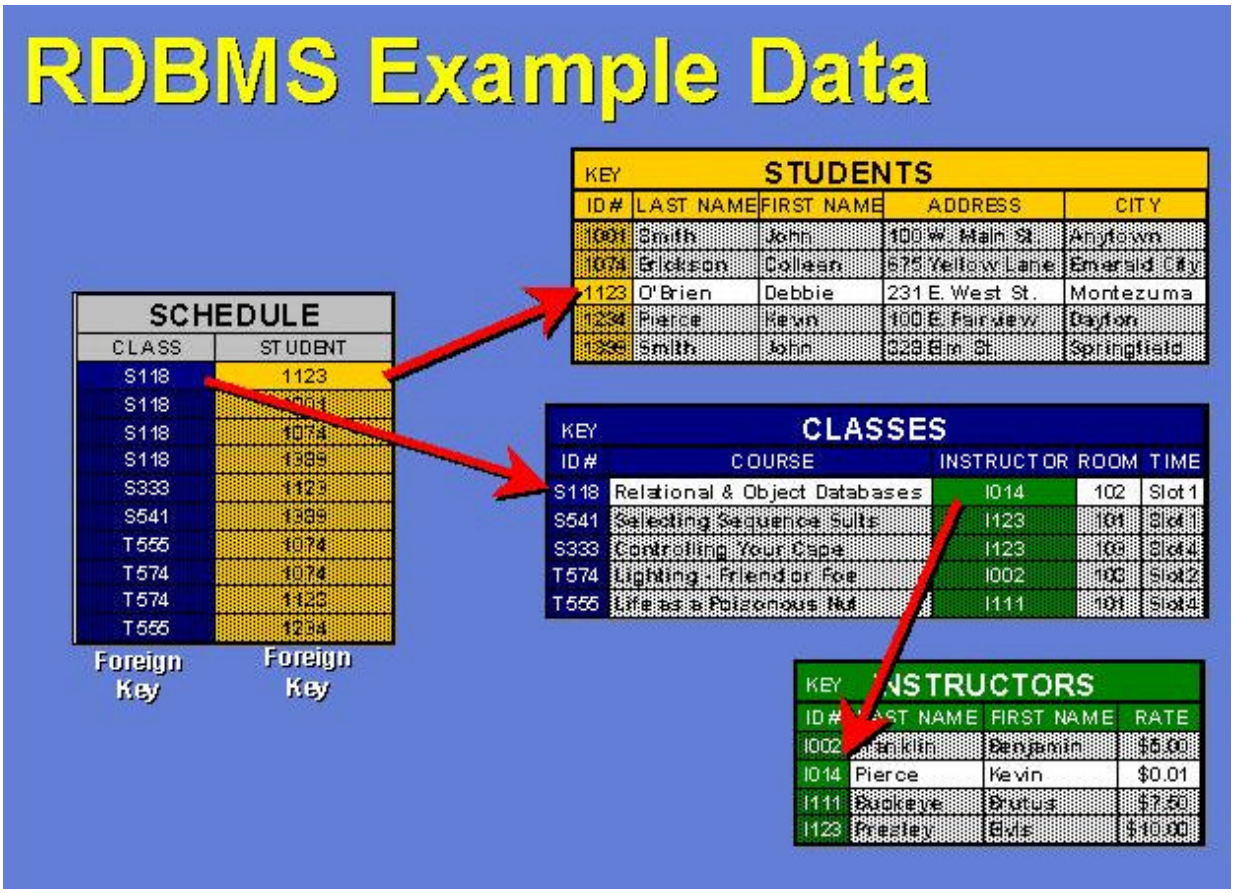
A database can be defined as a structured collection of data items about a specific topic. A database table can be defined as a group of similar records. A database table is like a spreadsheet where the columns represent the fields, or ‘attributes,’ and the rows represent the records, such that each row will be associated with a single record. A typical GIS links the graphical element, how it is displayed on the screen, with the associated record in the data table.

The SDSFIE has been designed for use with relational database management system (RDBMS) software. RDBMS software provide a means of managing the related data contained in one or more database tables. Examples of RDBMS software include Oracle (Oracle Corporation) and Access (Microsoft Corporation), SQLServer, and Informix. RDBMS software provides electronic

tools for defining relationships (i.e., connections) between the different database tables. These relationships can be defined as: (1) One to Many (most common); (2) One to One (rare, usually merge tables to one); and (3) Many to Many (needs a junction table). The following figures provide a visual representation of RDBMS terminology and relationships.







The name code of each *Attribute Table* is composed of eight characters, due to a design requirement to support both DOS and Windows 3.1 based GIS and database (e.g., dBase) programs. The first two characters, and next three characters in the table name, reference the parent *Entity Set*, and *Entity Class*, respectively. The last three characters in the table name represent a particular Attribute Table.

Some equivalent terms for *Attribute Table* used in GIS and relational database management system (RDBMS) software include:

"feature attribute table" - in MGE.

"attribute table" - in ArcInfo.

"database table" - in RDBMS software.

Domain Table. Domain tables contain standardized lists of permissible values for specific attributes. They provide a predefined finite set of allowable values, which may be enlarged by each user. Included are diverse tables of units of measure, types, styles, status, names, methods, materials, dispositions, sources,

dimensions, data, classes, building numbers, etc. The user can add to these lists and range domains installation-specific values as needed.

Two categories of Domain Tables are included in the SDSFIE: (1) List Domains which provide a "picklist" of allowable discrete values, and (2) Range Domains which provide a range (i.e., the minimum and maximum) of allowable discrete values.

Each domain table name code is restricted to eight characters with the first two characters being d_ . All attributes whose value is constrained by a domain value have a name code which ends in "_d". The name code for all attributes whose values are defined by the "unit of measure" Domain Table (d_uom) end in "_u_d".

Join Relationships. Join relationships are mechanisms by which relational databases link multiple records by a common attribute or item and provide access to the records through the use of queries. Join relationships are established in the SDSFIE/FMSFIE through the use of “Primary Key” attribute fields in a “parent” attribute table and “Foreign Key” attribute fields in related “child” attribute tables.

FMSFIE Data Model and Structure

Introduction

The first release of the Facility Management Standard for Facilities, Infrastructure, & Environment (FMSFIE) (formerly called Tri-Service Facility Management Standards (TSFMS), and Facility Management Standards (FMS)) was published with Release 1.80 of the SDSFIE (formerly called Tri-Service Spatial Data Standards (TSSDS)) (published on CD-ROM in February 1999).

The FMSFIE is being developed to:

- Provide "business" FM, "event," and temporal information (e.g., construction, operation, maintenance, repair, and inspection records) concerning the "real-world" features/objects depicted in the SDSFIE and Architectural, Engineering, and Construction (A/E/C)/CADD Standard.

- Provide the capability to link to and share data with "corporate" databases, computerized information management systems, computer maintenance management systems, and commercially available FM software.

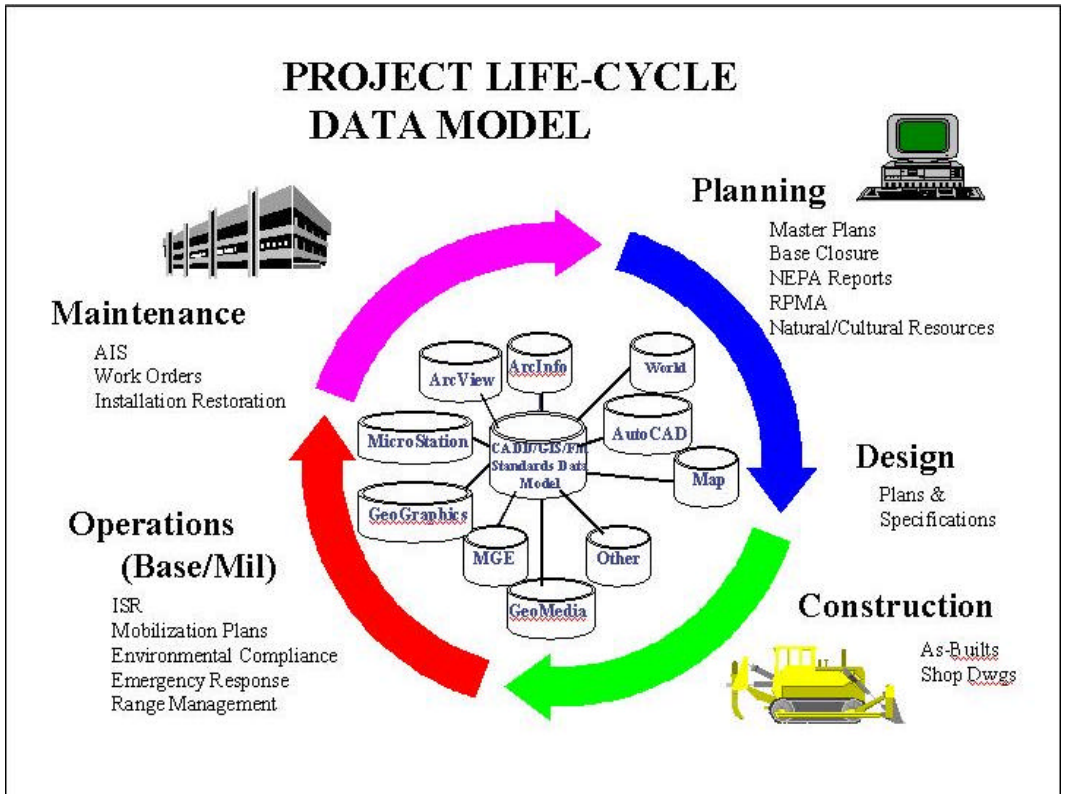
In developing the FMSFIE, the CADD/GIS Center did not want to develop a separate "stand-along" standard (i.e., a standard which contained graphic CADD and GIS standards different from those already depicted in the SDSFIE and A/E/C CADD Standards). The CADD/GIS Center's goals in development of the SDSFIE and A/E/C CADD Standard have been well defined, as described below:

- The A/E/C CADD Standard provide a CADD standard for the drawings prepared for design/construction projects. The emphases are on: (1) A graphic standard (i.e, colors, line types, fonts, and symbols) and (2) CADD level/layer assignments. The CADD drawings typically have a project specific "origin" (e.g., the origin of a building site plan may be based upon a temporary benchmark (TBM) established for the design and construction of that particular project) which is not geographically referenced (i.e., not geospatial, or directly related to a geographic coordinate system). For example, the A/E/C CADD standard would be used to prepare the necessary drawings for the construction of a building, it's parking area, and interior and exterior utilities.

- The SDSFIE provides a standard for the development of a GIS or CADD drawings where all features (i.e., "real-world" objects) are geographically referenced. The emphases are on: (1) The geospatial referencing of each feature and (2) The collection and maintenance of accurate data concerning each feature, which is stored in database tables. For example, the SDSFIE

would be used to: (1) Depict the graphic locations (using GIS or CADD software) of all buildings, parking areas, and exterior utilities at a military installation or civil works project, and (2) generate a database schema for geospatial feature attribute data.

The goal of the CADD/GIS Center is to provide a seamless graphic and nongraphic "life-cycle" CADD/GIS/FM project data model (see above Figure). For example, the ultimate goal is to permit the CADD drawings developed during the design and construction phase to be readily available for use in a GIS and for facility management, and vise versa. In a broad sense, the term "facility management" comprises the entire "life-cycle" project data model, thereby encompassing all three of the CADD/GIS Center's CADD/GIS/FM standard development efforts. In other words, to perform "facility management" activities, an organization will require use of: (1) GIS or CADD (as defined in the SDSFIE), (2) CADD (as defined by the A/E/C CADD standard), and (3) "business", event, and temporal data as defined by the FMSFIE.



FACILITY MANAGEMENT STANDARD DATA MODEL

Several different strategies and options were evaluated during 1997 and 1998 for integration of the FMSFIE with the CADD/GIS Center's CADD and GIS standards development efforts (i.e., the SDSFIE and A/E/C CADD Standard). In early 1998, the following two options were presented to the FMSFIE Task Group, Center's Field Working Groups (FWGs), and Center's Oversight Groups (i.e., Executive Working Group (EWG) and Field Technical Advisory Group (FTAG)):

- Option 1: Incorporate the FMSFIE within the current SDSFIE Data Model. This option would involve the development and incorporation of FM Entity Classes within the appropriate existing SDSFIE Entity Sets.

- Option 2: Develop the FMSFIE as a separate standard. This option would involve the development of separate FM Entity Sets built around a data model structure similar to the existing SDSFIE Data Model.

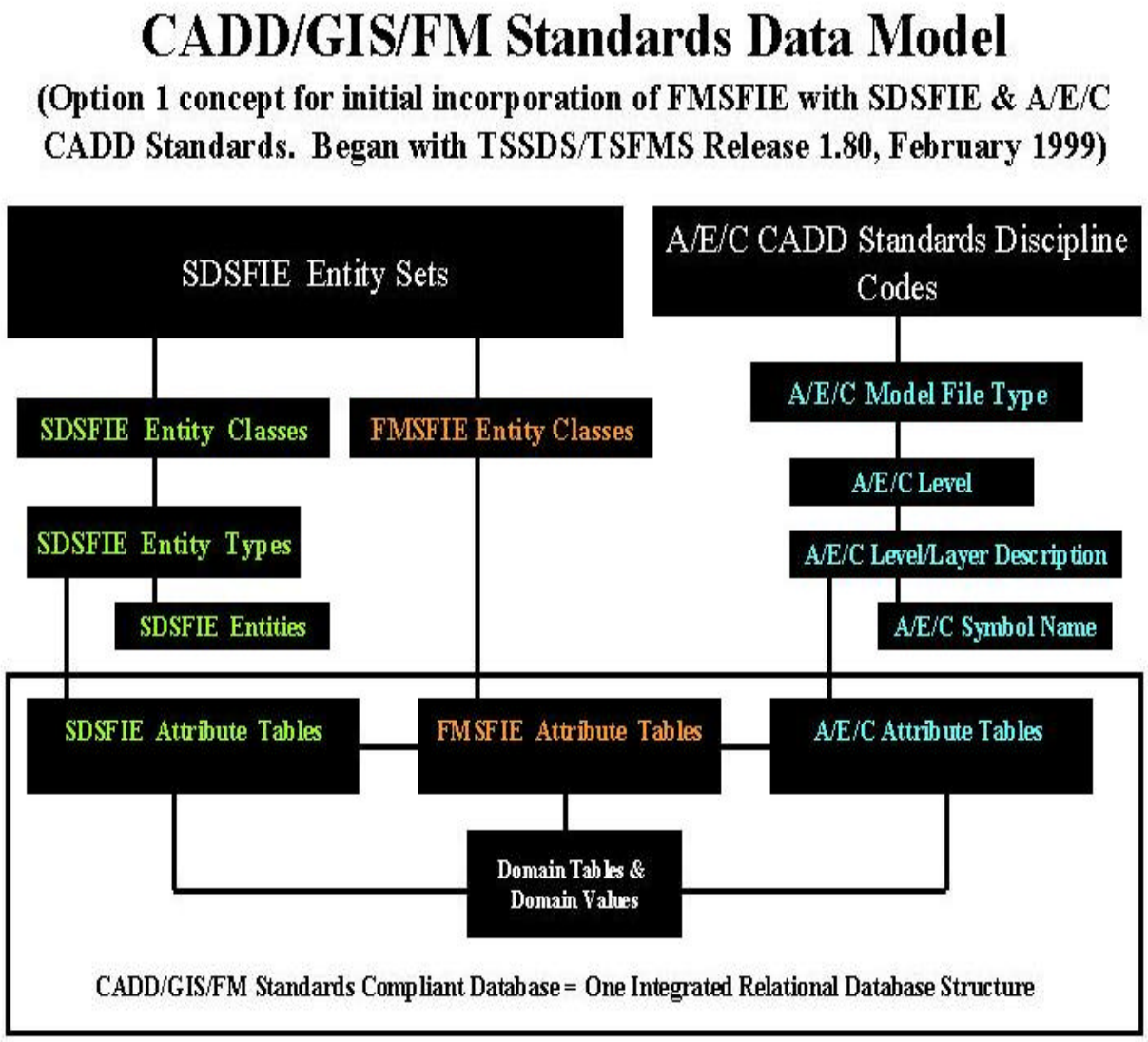
Option 1 was chosen and implemented for the initial development of the FMSFIE, beginning with the TSSDS/TSFMS Release 1.80.

In March 1999, the FMSFIE Task Group consisting of representatives of the Facility Management Field User Group and other FM experts within the DoD developed the following definition and scope for the FMSFIE:

> *The scope of Facility Management Standard is the data describing the control and reporting of real property and derived entities that must be considered in its use.*

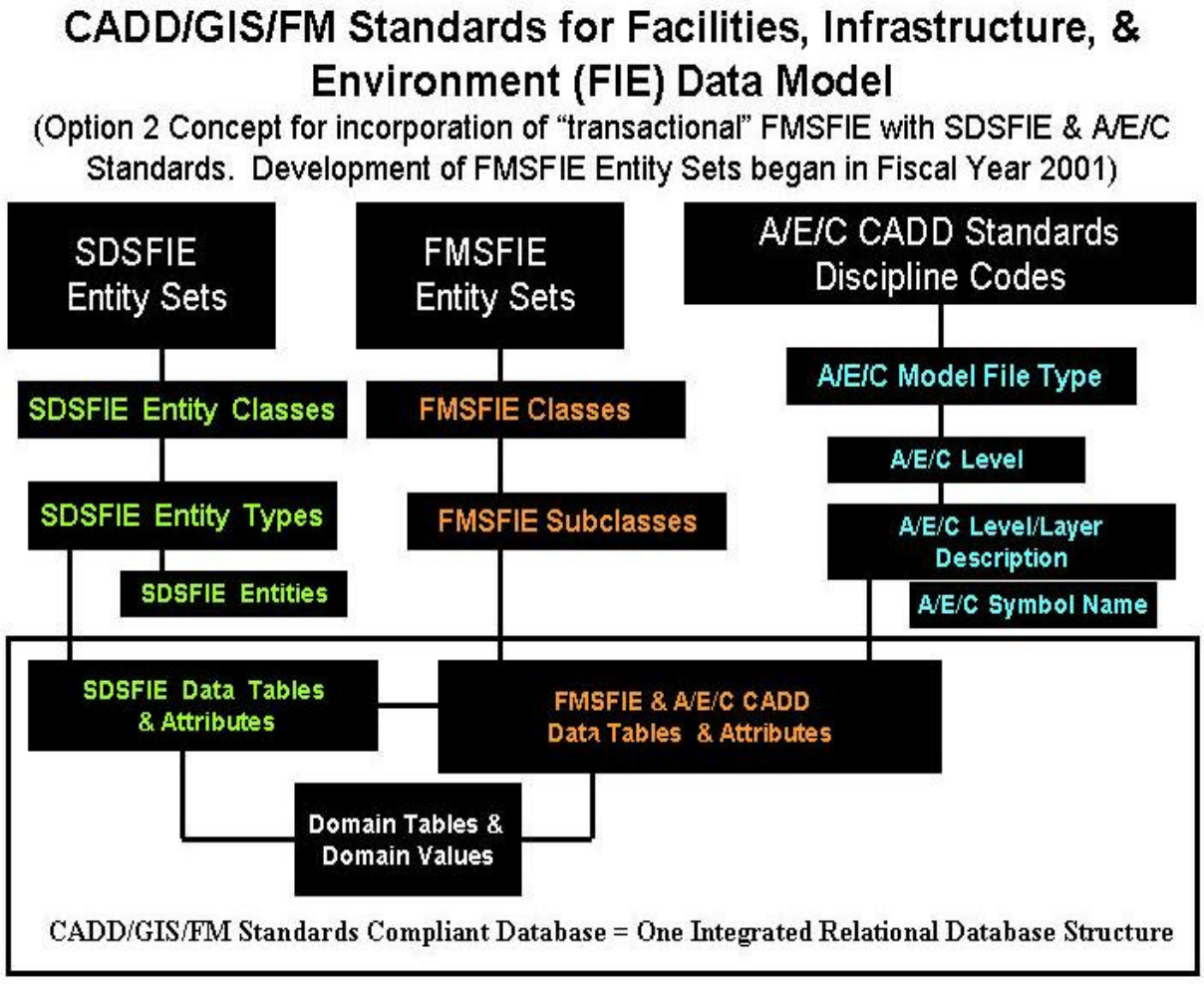
Attribute Tables not directly linked to an entity but which contain data required for a “business process” or function, along with data and relationships linked through specific data field ids which may be queried for geospatial and relational analysis, are classified as “nongraphic” (i.e., FMSFIE) attribute tables.

A conceptual model how the SDSFIE, FMSFIE and A/E/C CADD Standard relate to each other is depicted in the following figure:



In Fiscal Year 2000, a new FMSFIE Strategic Plan was prepared and approved by the CADD/GIS Technology Center's Standards Working Group (SWG) and Corporate Staff (CS). The Strategic Plan provided a framework and strategy for evolution of the FMSFIE to a "transactional" (i.e., Option 2 concept discussed above) data model closely integrated with the SDSFIE & A/E/C CADD Standard. Development of the "transactional" FMSFIE data model and standards began in Fiscal Year 2001.

A conceptual model how the SDSFIE, "transactional" FMSFIE, and A/E/C CADD Standard will relate to each other is depicted in the following figure:

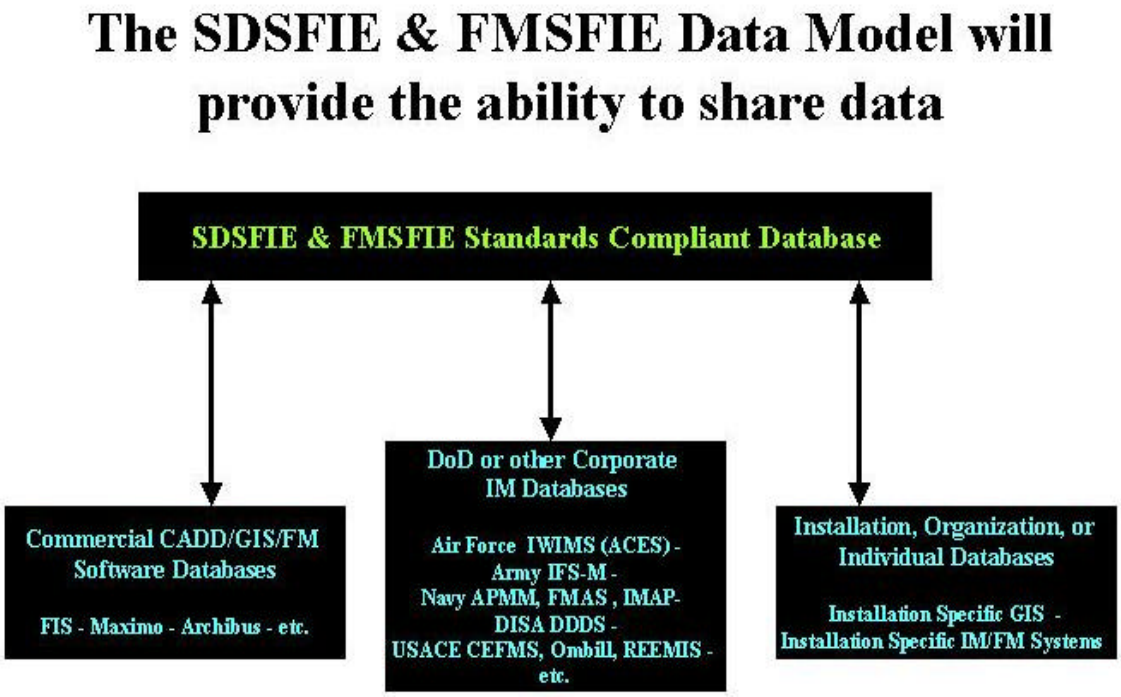


SDSFIE/FMSFIE Software Applications

The SDSFIE and FMSFIE are distributed via CD-ROM and the Internet (http://tsc.wes.army.mil). A user-friendly interactive Microsoft Windows-based software application installs the SDSFIE/FMSFIE "Browser" and "Generator" applications on desktop computers and networks (Windows 95, 98, NT, and 2000). The "Browser" application provides viewing and printing capability.

The "Generator" applications generate Structured Query Language (SQL) code for various GIS databases (Oracle, Intergraph RIS, and SQLServer) and the database tables for Microsoft Access. Appendix C provides a listing of the various transformations conducted by the "Generator".

The CADD/GIS Technology Center has developed "Maintainer" software for use in updating and maintenance of the SDSFIE and FMSFIE. Appendix D contains a listing of the "Maintainer" validation rules.



Appendix A

SDSFIE and FMSFIE Maintenance Database Data Dictionary

Release 2.00

Note: The SDSFIE and FMSFIE are developed and maintained by The CADD/GIS Technology Center in a Microsoft Access database (currently in Access 97 digital format). A data dictionary for the SDSFIE/FMSFIE Maintenance Databases provided in Appendix A. The SDSFIE/FMSFIE Browser software provides a "User-Friendly" tool for viewing and printing the various components of the SDSFIE/FMSFIE databases. The SDSFIE/FMSFIE Generator software permits the generation of database tables in a RDBMS digital format.

Entity Set

Field Name	Data Type	Field Size	Description
Entity Set Name	Text	32	Name of the Entity Set.
Entity Set Abbreviation	Text	2	A code designation (abbreviation) of the Entity Set name; used for naming Entities and Attribute Tables.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Definition	Memo		The Entity Set Definition. An explanation of the use, source, or relationship of the Entity Set; 5000 characters.
Edit Status	Text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
Discipline	Text	46	Used for development of predefined "Filters".
Entity Class Prefix	Text	50	The Entity Set representation as a prefix of the Class Name.
Common Name Prefix Text	Text	50	The Entity Set representation as a prefix of the Class Common Name.

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Entity Sets

Entity Class

Field Name	Data Type	Field Size	Description
Key Column	Number	Double	The unique identifier for each Entity Class; created to facilitate system sorting and in creating join relationships.
Entity Class Name	Text	32	Name of the Entity Class.
Entity Set Name	Text	32	Name of the parent Entity Set.
Entity Class Abbreviation	Text	3	An abbreviation of the Entity Class name used for naming Entities and Attribute Tables.
Map Prefix	Text	8	File name prefix (code) of a map (drawing) (e.g., MGE, MicroStation, AutoCAD).
Version	Number	Double	SDSFIE/FMSFIE Release number.
Definition	Memo		The Entity Class Definition. An explanation of the use, source, or relationship of the Entity Class; 5000 characters.
IDEF Model Name	Text	8	The file name used as a prefix for the IDEF file.
Standards	Text	5	Acronym for data standard of which the Entity Class is a component; e.g., SDSFIE, FMSFIE, AEC.
Edit Status	Text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
Discipline	Text	46	Used for development of predefined "Filters".
Table Prefix	Text	64	The prefix used to generate the Table Common Name.

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Entity Classes

Entity Type

Field Name	Data Type	Field Size	Description
Key Column	Number	Long Integer	The unique identifier for each Entity Type; created to facilitate system sorting and in creating join relationships.
Entity Type Name	Text	50	Name of the Entity Type.
Entity Class Name	Text	32	Name of the parent Entity Class.
Entity Set Name	Text	32	Name of the parent Entity Set.
Object Type	Text	20	Entity type object type (G/GT Polygon, String/Chain, or Point).
Polygon Coverage	Text	8	File name prefix of a polygon coverage (Arc/Info).
Line Coverage	Text	8	File name prefix of a string/chain coverage (Arc/Info).
Point Coverage	Text	8	File name prefix of a point coverage (Arc/Info).
Table Name	Text	8	Name of the "attached" Attribute Table providing data concerning the Entity Type.
Discriminator Name	Text	10	Name of the Attribute (database table field) providing a discriminator value for the Entity Type.
Domain Table	Text	8	Name code of the Domain Table which provides discriminator values for the Entity Type.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Definition	Memo		The Entity Type Definition. An explanation of the use, source, or relationship of the Entity Type; 5000 characters.
Source	text	40	Source of the Entity Type (e.g., name of GIS, commentor, etc.).
Standards	text	5	Acronym for data standard of which the Entity Type is a component; e.g., SDSFIE, FMSFIE, AEC.

Entity Type (Cont.)

Edit Status	text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
Discipline	text	46	Used for development of predefined "Filters".

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Entity Types

Entity (CADD & CADD-Based GIS)

Field Name	Data Type	Field Size	Description
Key Column	Number	Long Integer	The unique identifier for each Entity; created to facilitate system sorting and in creating join relationships.
Entity Name	Text	32	Name of the Entity.
Entity Type Name	Text	50	Name of the parent Entity Type.
Position	Number	Integer	Ordered position for sorting Entities for each Entity Type.
Entity Alphabetic Code	Text	12	A unique alphanumeric code that identifies the Entity; Can be used as the Layer name in AutoCAD.
Table Name	Text	8	Name code of the "attached" Attribute Table providing data directly related to the parent Entity Type.
Discriminator Value	Text	16	Attribute value that is a discriminating property of the Entity.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Feature Type	Text	1	Code designating the Entity Type object type (boundary - B, centroid - C, line - L, point - P, text - T, or label - A).
Level or Layer	Number	Integer	Level or layer number (1 to 63).
Line Type	Number	Integer	Entity line style or type indicated by a whole number.
Line Width	Number	Integer	Entity line width or weight indicated by a whole number.
Color	Number	Integer	Entity color indicated by a whole number from 0 to 255.
Element Type	Text	18	Element type as specified for Entity placement.
Text Height	Number	Double	Text height as specified for entity placement.
Text Width	Number	Double	Text width as specified for entity placement.
Text Line Space	Number	Double	Space between lines of text as specified for entity placement.
Text Line Length	Number	Integer	Maximum number of characters in a line of text as specified for entity placement.

Entity (CADD & CADD-Based GIS) (Cont.)

Text Font	Text	32	Text font as specified for Entity text placement.
Symbol Character	Text	1	A text character that depicts a symbol.
Text Justification	Text	3	Text justification in reference to the text origin as specified for entity placement. Valid options are "Left Middle Top" (LMT), "Left Middle Center" (LMC), "Left Middle Bottom" (LMB), "Left Top" (LT), "Left Center" (LC), "Left Bottom" (LB).
Symbol Library	Text	14	File name prefix of a library of symbols.
Symbol Name	Text	6	Name of a symbol as specified for Entity placement.
Symbol Scale	Number	Double	Scale of a symbol relative to its original size, as specified for Entity placement.
Minimum Display Scale	Number	Long Integer	Minimum reciprocal fraction of a map scale at which an Entity should be displayed.
Maximum Display Scale	Number	Long Integer	Maximum reciprocal fraction of a map scale at which an Entity should be displayed.
Label x Offset	Number	Double	Offset distance between the Entity and its Attribute label in the Easting direction.
Label y Offset	Number	Double	Offset distance between the Entity and its Attribute label in the Northing direction.
Annotation Prefix	Text	8	File name prefix of an Arc/Info annotation file.
Symbol Number	Number	Long Integer	Unique identifier number of an ARCINFO marker, line, or shade symbol.
Source	Text	40	Source of the Entity (e.g., name of GIS, commentor, etc.).

Entity (CADD & CADD-Based GIS) (Cont.)

Standards	Text	5	Acronym for data standard of which the Entity is a component; e.g., SDSFIE, FMSFIE, AEC.
Edit Status	Text	10	The present status of the item: i.e., "original", "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current release, it would be denoted as "update". If an existing item was not changed it would be denoted as "original".
Discipline	Text	46	Used for development of predefined "Filters".
Class Index	Text	5	The Entity Class Prefix

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Entities

Attribute Table

Field Name	Data Type	Field Size	Description
Key Column	Number	Long Integer	The unique identifier for each Attribute Table; created to facilitate system sorting and in creating database join relationships.
Table Name	Text	8	Name code of the Attribute Table.
Entity Set Name	Text	32	Name of the parent Entity Set.
Entity Class Name	Text	32	Name of the parent Entity Class.
Common Name	Text	50	The common name (long name) for the Attribute Table.
Table Type	Number	Integer	Code designating the class of Attribute Table usage (system - 4, graphic - 16, or non-graphic - 64). Small Integer.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Definition	Memo		The Attribute Table definition. An explanation of the use, source, or relationship of the table; 5000 characters.
Standards	Text	5	Acronym for data standard of which the Attribute Table is a component; e.g., SDSFIE, FMSFIE, AEC.
Edit Status	Text	10	The present status of the item: i.e., "original", "new" or "update." For example, if the item is available for the first time with the current Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current Release, it would be denoted as "update". If an existing item was not changed it would be denoted as "original".
Discipline	Text	46	Used for development of predefined "Filters".
Real Property?	Yes/No		A flag denoting whether the Attribute Table contains data required for upward reporting of DoD real property legal requirements.

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Tables

Attributes

Field Name	Data Type	Field Size	Description
Table Name	Text	8	Name code of the parent Attribute Table.
Attribute Name	Text	10	Name code of the Attribute database table field).
Common Name	Text	50	Common (long name) name for the Attribute.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Required	Yes/No		Indicates whether or not the Attribute is considered to be "required"; If designated by "Yes", a value should be provided. If designated by "No", the provision of a value is optional.
Displayable	Yes/No		Indicates whether or not the Attribute value is considered to be displayable on a map or drawing.
Nulls Allowed	Yes/No		Indicates whether or not "nulls" are allowed; If designated by "Yes", many RDBMS require a value to be input before a record can be added to the database.
Discriminator	Yes/No		Indicates whether or not the Attribute provides a "discriminating" property for an Entity Type.
Position	Number	Integer	Numeric order of the Attribute within the Attribute Table.
Data Type	Text	12	Attribute data type; C = character (text, maximum of 240 ASCII characters), R = Real (number, single precision floating point); I = Long Integer (number, 32-bit integer, date is entered as an integer (YYYYMMDD, time of day on a 24-hour clock is entered as an integer (HHMMSS)), S = Short Integer (number, small integer), D = Double (number, double precision). See appendix B.
Character Length	Number	Integer	Number of character spaces for Character type data.
Domain Name	Text	32	Name of the Domain (Valid Value) Table.

Attributes (Cont.)

Domain Table	Text	8	Name code of the Domain (Valid Value) Table.
Default Value	Text	240	Default Attribute Value (if applicable).
Definition	Memo		Attribute definition. An explanation of the use, source, or relationship of the Attribute; up to 5000 characters.
Domain Number	Number	Long Integer	A unique Domain Table identifier created for system sorting and relating; Integer.
Source	Text	40	Source of the Attribute (e.g., name of GIS, data standard, commentor, etc.).
Standards	Text	5	Acronym for data standard of which the table is a component; e.g., SDSFIE, FMSFIE, AEC.
Edit Status	Text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
DISA Counter	Number	Long integer	A unique numeric identifier (counter id) as designated by Defense Information Systems Agency (DISA) for approved data elements in the Defense Data Dictionary System (DDDS).
FLAG	Yes/no		A flag denoting whether the Attribute is required for upward reporting of a DoD real property legal requirement.

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Attributes

Domain Tables

Field Name	Data Type	Field Size	Description
Key Column	Number	Long Integer	The unique identifier for each Domain Table; created to facilitate system sorting and in creating database join relationships.
Domain Name	Text	32	Name of a Domain (valid value) Table.
Domain Type	Text	1	Type of Domain Table (range - R, or list - L).
Occurrence	Number	Integer	The number of times the Domain Table is referenced in the current SDSFIE/FMSFIE Release.
Number of Values	Number	Integer	The number of Values in the Domain Table.
Table Name	Text	8	Name code of the Domain Table.
Discriminator?	Yes/No		Does the Domain Table provide discriminating values for an Entity Type?
Definition	Text	240	An explanation of the use, source, or relationship of the domain; 5000 characters.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Edit Status	Text	10	The present status of the item: i.e., "original", "new" or "update." For example, if the item is available for the first time with the current Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current Release, it would be denoted as "update". If an existing item was not changed it would be denoted as "original".
Discipline	Text	46	Used for development of predefined "Filters".
Local	Yes/No		Designates whether or not local domain values can be used.

SDSFIE/FMSFIE Maintenance Database Name - tssdsdom.mda
Table Name - Domains

List Domains

Field Name	Data Type	Field Size	Description
Key Column	Number	Long Integer	The unique identifier for each Domain Table; created to facilitate system sorting and in creating database join relationships.
Domain Name	Text	32	Name of the Domain Table.
Domain Table	Text	8	Name code of the Domain Table.
Value	Text	16	Name code of a domain value.
Definition	Text	240	Domain value definition; an expanded description of the list domain value.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Reference	Text	50	Source of the Domain Value (e.g., name of GIS (REEGIS), data standard (ISO, ANSI, ASTM, DISA), etc.
Edit Status	Text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
Full Value	Text	35	A common (long) name for a domain value.
Flag	Yes/No		Used as a part of the diagnostics process in Domains, indicating whether or not the domain is used for an attribute.

SDSFIE/FMSFIE Maintenance Database Name - tssdsdom.mda
Table Name - List Domains

Range Domains

Field Name	Data Type	Field Size	Description
Key Column	Number	Long Integer	The unique identifier for each Domain Table; created to facilitate system sorting and in creating database join relationships.
Table Name	Text	8	Name code of the Domain Table.
Domain Name	Text	32	Name of the Domain Table.
Minimum Value	Number	Double	Minimum numeric domain value for an attribute.
Maximum Value	Number	Double	Maximum numeric domain value for an attribute.
Version	Number	Double	SDSFIE/FMSFIE Release number.
Reference	Text	50	Source of the Domain Value (e.g., name of GIS (REEGIS), data standard (ISO, ANSI, ASTM, DISA), etc.
Edit Status	Text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
Discipline	Text	46	Used for development of predefined "Filters".

SDSFIE/FMSFIE Maintenance Database Name - tssdsdom.mda
Table Name - Range Domains

Join Relationships

Field Name	Data Type	Field Size	Description
Key Column	number	Long integer	The unique identifier for each Join Relationship.
First Table Name	text	8	Name code of Parent Attribute Table.
First Attribute Name	Text	20	Primary Key attribute (database field); provides a unique identifier for each record in the database; used to create join relationships between RDBMS tables.
Second Table Name	Text	8	Name code of Child Attribute Table.
Second Attribute Name	Text	20	Foreign Key attribute (database field); provides a unique identifier for each record in the database; used to create join relationships between RDBMS tables.
Relationship	Text	240	Parent Table.Primary Key = Child Table.Foreign Key
Version	Number	Double	SDSFIE/FMSFIE Release number.
Edit Status	Text	10	The present status of the item: i.e., "new" or "update." For example, if the item is available for the first time with the current SDSFIE/FMSFIE Release (e.g., Release 2.00), it would be denoted as "new". If an existing item was revised with the current SDSFIE/FMSFIE release, it would be denoted as "update".
Rule	Text	100	CADD/GIS Center defined field.

SDSFIE/FMSFIE Maintenance Database Name - tssdslib.mda
Table Name - Join Relations

Appendix B

Entity Classes

Release 2.00

Entity Set - Auditory

Entity Class Name	Entity Class Code	Design File Prefix
auditory_management	mgt	aumgt
auditory_noise	noi	aunoi

Entity Set - Boundary

Entity Class Name	Entity Class Code	Design File Prefix
boundary_economic	eco	bdeco
boundary_jurisdiction	jur	bdjur
boundary_public_safety	pub	bdpub

Entity Set - Buildings

Entity Class Name	Entity Class Code	Design File Prefix
buildings_general	gen	bggen
buildings_space	spa	bgspa

Entity Set - Cadastre

Entity Class Name	Entity Class Code	Design File Prefix
cadastre_county_property	cou	cdcou
cadastre_federal_dod_property	dod	cddod
cadastre_federal_nondod_property	fed	cdfed
cadastre_municipality_property	mun	cdmun
cadastre_plss	pls	cdpls
cadastre_real_estate	rel	cdrel
cadastre_state_property	sta	cdsta
cadastre_township_property	twn	cdtwn
cadastre_tribal_reserve_property	tri	cdtri

Entity Set - Climate

Entity Class Name	Entity Class Code	Design File Prefix
climate_general	gen	clgen
climate_precipitation	pcp	clpcp
climate_temperature	tmp	cltmp

Entity Set - Common

Entity Class Name	Entity Class Code	Design File Prefix
common_general	gen	cmgen
common_grid	grd	cmgrd
common_media	med	cmmed
common_metadata	met	cmmet

Entity Set - Communications

Entity Class Name	Entity Class Code	Design File Prefix
communications_cable_trans	ctr	coctr
communications_device	dev	codev
communications_enclosed_struct	est	coest
communications_equipment	eqp	coeqp
communications_horiz_struct	hst	cohst
communications_junction	jun	cojun
communications_support	sup	cosup
communications_vertical_struct	vst	covst
communications_wireless_trans	wtr	cowtr

Entity Set - Cultural

Entity Class Name	Entity Class Code	Design File Prefix
cultural_archeological	arc	crarc
cultural_general_fm	gen	crgen
cultural_historic	hst	crhst
cultural_management	mgt	crmgt

Entity Set - Demograhics

Entity Class Name	Entity Class Code	Design File Prefix
demograhics_neighborhood	nei	denei

Entity Set - Ecology

Entity Class Name	Entity Class Code	Design File Prefix
ecology_habitat	hab	echab

Entity Set - Environmental Hazards

Entity Class Name	Entity Class Code	Design File Prefix
env_haz_asbestos_fm	acm	Ehacm
Env_haz_air_pollution	air	Ehair
Env_haz_air_quality_fm	aqm	Ehaqm
Env_haz_building_env_concern	bdh	Ehbdh
Env_haz_characterization	cha	Ehcha
Env_haz_emergency_preparedness	emp	Ehemp
Env_haz_environmental_manage_fm	enm	Ehenm
Env_haz_field_measurements_fm	efm	Ehefm
Env_haz_general	gen	Ehgen
Env_haz_general_pollution	pol	Ehpol
Env_haz_groundwater_pollution	gwt	Ehgwt
Env_haz_hazmat_hazwaste	hmw	Ehhmw
Env_haz_indoor_air_fm	iah	Ehiah
Env_haz_lead_paint_fm	lpt	Ehlpt
Env_haz_materiel_fm	Hzm	Ehhzm
Env_haz_mun_materiel_fm	mun	Ehmun
Env_haz_mun_waste_fm	muw	Ehmuw
Env_haz_munitions_remediation	mrm	Ehmrm
Env_haz_pcb_fm	pcb	Ehpcb
Env_haz_pollution_remediation	rem	Ehrem
Env_haz_reg_tank_fm	rst	Ehrst
Env_haz_regulated_tanks	tnk	Ehtnk
Env_haz_remediation_fm	rmg	Enrmg
Env_haz_sediment_pollution	sed	Ehsed
Env_haz_sites	sit	Ehsit
Env_haz_soil_pollution	soi	Ehsoi
Env_haz_solid_waste	swm	Ehswm
Env_haz_surface_water_pollution	swt	Ehswt
Env_haz_swater_discharge_fm	swd	Ehswd
Env_haz_toxic_substance_fm	tsm	Ehtsm
Env_haz_waste_fm	hzw	ehhzw

Entity Set - Fauna

Entity Class Name	Entity Class Code	Design File Prefix
Fauna_amphibia	amp	Faamp
Fauna_aves	ave	faave
Fauna_crustacea	cru	facru
Fauna_general_fm	gen	fagen
Fauna_habitat	hab	fahab
Fauna_insecta	ins	fains
Fauna_mammalia	mam	famam
Fauna_management	mgt	famgt
Fauna_mollusca	mol	famol
Fauna_pisces	pis	fapis
Fauna_reptilia	rep	farep

Entity Set - Flora

Entity Class Name	Entity Class Code	Design File Prefix
flora_bryoid	bry	flbry
flora_epiphyte	epi	flepi
flora_general_fm	gen	flgen
flora_habitat	hab	flhab
flora_herb	hrb	flhrb
flora_liana	lia	fllia
flora_management	mgt	flmgt
flora_management_fm	fmg	flfmg
flora_preservation	prz	flprz
flora_shrub	shr	flshr
flora_thallophyte	thl	flthl
flora_tree	tre	fltre

Entity Set - Future Projects

Entity Class Name	Entity Class Code	Design File Prefix
future_projects_general	gen	fpgen

Entity Set - Geodetic

Entity Class Name	Entity Class Code	Design File Prefix
geodetic_survey	srv	gdsrv
geodetic_survey_fm	sri	gdsri
geodetic_usgs	sgs	gdsgs

Entity Set - Geology

Entity Class Name	Entity Class Code	Design File Prefix
geology_lithology	lth	gelth
geology_subsurface	sub	gesub
geology_subsurface_fm	sui	gesui
geology_surface	sur	gesur
geology_tectonic	tec	getec
geology_tectonic_fm	tei	getei

Entity Set - Hydrology

Entity Class Name	Entity Class Code	Design File Prefix
hydrography_coastal_zone	czn	hyczn
hydrography_floodplain	flp	hyflp
hydrography_hydrobasin	hdb	hyhdb
hydrography_ice_and_snow	ice	hyice
hydrography_management	mgt	hymgt
hydrography_subsurface	sub	hysub
hydrography_subsurface_fm	sui	hysui
hydrography_surface	sur	hysur
hydrography_surface_fm	suf	hysuf
hydrography_wetland	wet	hywet

Entity Set - Improvement

Entity Class Name	Entity Class Code	Design File Prefix
improvement_athletic_recreation	ath	imath
improvement_channel_master_plan	cmp	imcmp
improvement_flood_control	fdc	imfdc
improvement_flood_control_fm	fdi	imfdi
improvement_general	gen	imgen
improvement_general_fm	gni	imgni
improvement_machinery	mac	immac
improvement_outdoor_recreaction	rec	imrec
improvement_waterways_engr	ero	imero
improvement_waterways_engr_fm	eri	Imeri
improvement_wells	wel	Imwel
improvement_wells_fm	wli	imwli

Entity Set - Land Status

Entity Class Name	Entity Class Code	Design File Prefix
land_status_general	gen	lsgen
land_status_land_condition	cnd	lscnd
land_status_land_management	mgt	lsmgt

Entity Set - Landform

Entity Class Name	Entity Class Code	Design File Prefix
landform_bathymetry	bth	lfbth
landform_bathymetry_fm	bti	lfbti
landform_hypsography	hyp	lfhyp
landform_topography	top	lftop

Entity Set - Military Operations

Entity Class Name	Entity Class Code	Design File Prefix
military_air_operations	air	mlair
military_air_operations_fm	ari	mlari
military_public_relations	pub	mlpub
military_range	rng	mlrng
military_range_fm	ran	mlran
military_safety	sft	mlsft
military_security	sec	mlsec
military_training	tng	mltng
military_training_fm	tni	mltni

Entity Set - Olfactory

Entity Class Name	Entity Class Code	Design File Prefix
olfactory_general	gen	olgen

Entity Set - Soil

Entity Class Name	Entity Class Code	Design File Prefix
soil_general	gen	sogen
soil_general_fm	gni	sogni

Entity Set - Transportation

Entity Class Name	Entity Class Code	Design File Prefix
transportation_air	air	trair
transportation_airfield_facility	afl	trafl
transportation_airfield_fm	afi	trafi
transportation_general	gen	trgen
transportation_general_fm	gni	trgni
transportation_lock_system	loc	trloc
transportation_marine	mar	trmar
transportation_marine_transportation	nav	trnav
transportation_pedestrian	ped	trped
transportation_ports_and_harbors	hrb	trhrb
transportation_railroad	rrd	trrrd
transportation_vehicle	veh	trveh
transporation_vehicle_fm	vhi	trvhi

Entity Set - Utilities

Entity Class Name	Entity Class Code	Design File Prefix
utilities_cntrl_mntr_system	ecm	utecm
utilities_cntrl_mntr_system_fm	cmi	utcmi
utilities_compressed_air_system	air	utair
utilities_electrical_ext_light	exl	utexl
utilities_electrical_system	ele	utele
utilities_electrical_system_fm	eli	uteli
utilities_fuel_system	ful	utful
utilities_fuel_system_fm	fui	utfui
utilities_general	gen	utgen
utilities_general_fm	gni	utgni
utilities_heat_cool_system	hcs	uthcs
utilities_heat_cool_system_fm	hci	uthci
utilities_industrial_system	inw	utinw
utilities_industrial_system_fm	iwi	utiwi
utilities_natural_gas_system	gas	utgas
utilities_natural_gas_system_fm	gsi	utgsi
utilities_saltwater_system	swt	utswt
utilities_storm_system	sto	utsto
utilities_storm_system_fm	sti	utsti
utilities_wastewater_system	wwt	utwwt
utilities_wastewater_system_fm	wti	utwti
utilities_water_system	wat	utwat
utilities_water_system_fm	wai	utwai

Entity Set - Visual

Entity Class Name	Entity Class Code	Design File Prefix
Visual_aesthetic_view	aes	vases
Visual_general	gen	vsgen

Appendix C

SDSFIE and FMSFIE Generator Transformations

Release 2.00

The following is a list of SDSFIE/FMSFIE Generator transformations made during the SQL Generation process. These transformations convert the SDSFIE/FMSFIE "Universal" data types to the individual RDBMS data types.

RIS Conversions

SDSFIE/FMSFIE Data Type	RIS Data Type
C - Character	VARCHAR
R - Real	REAL
I - Integer	INTEGER
S - Short In teger	SMALLINT
D - Double	DOUBLE

Informix Conversions

SDSFIE/FMSFIE Data Type	Informix Data Type
C - Character	VARCHAR
R - Real	SMALLFLOAT
I - Integer	INTEGER
S - Short Integer	SMALLINT
D - Double	FLOAT

Oracle Conversions

SDSFIE/FMSFIE Data Type	Oracle Data Type
C - Character	VARCHAR2
R - Real	REAL
I - Integer	NUMBER (10,0)
S - Short Integer	NUMBER (5,0)
D - Double	NUMBER

SQL Server Conversions

SDSFIE/FMSFIE Data Type	SQL Server Data Type
C - Character	VARCHAR
R - Real	FLOAT
I - Integer	INTEGER
S - Short Integer	SMALLINT
D - Double	REAL

Access Conversions

SDSFIE/FMSFIE Data Type	Access Data Type
C - Character	Text
R - Real	Number (Single)
I - Integer	Number (Long Integer)
S - Short Integer	Number (Short Integer)
D - Double	Number (Double)

Appendix D

SDSFIE/FMSFIE Maintainer Software Validation Rules

Release 2.00

Validation Rules for the SDSFIE/FMSFIE Maintainer Software

Entity Sets - - - -

1. Each *Entity Set Name* **must** be unique and **must not** contain spaces.
2. Each *Entity Set Abbreviation* **must** be unique.
3. Each Entity Set **must** contain a *Definition*.
4. Each Entity Set *Common Name Prefix* **must** be unique.

Entity Classes - - - -

1. Each Entity Class **must** reference a valid *Entity Set Name*.
2. The *Entity Class Name* **must** begin with the complete Entity Set Entity Class Prefix.
3. Each Entity Class *Key Column* **must** be unique, be > 0, and may **never** be changed. These *Key Columns* may **never** be reused. If a class is deleted, that *Key Columns* number is retired.
4. Each *Entity Class Name* **must** be unique **and must not** contain spaces**.**
5. Each *Entity Class Abbreviation* **must** be unique within an Entity Set and, once assigned, may **never** be changed.
6. Each *Map Prefix* shall consist of the referenced Entity Set Abbreviation and the *Entity Class Abbreviation*
7. An *Entity Class Name* may be changed, but the *Map Prefix* and *Key Columns* **must not** be changed.
8. If an Entity Class contains FMS tables, it is coded as being a FMS class.
9. FMS Classes **must not** contain any Entity Types.
10. Each IDEF Model Name shall begin with the *Map Prefix* and end with a three digit representation of the SDS Release; e.g. 180.
11. Entity Classes coded as FMS classes must have a *Entity Class Name* ending in "_fm".
12. Each Entity Class *Table Prefix* must begin with the complete Entity Set *Common Name Prefix*.

Entity Types - - - -

1. Each Entity Type **must** reference a valid *Entity Class Name*.
2. Each Entity Type **must** reference a valid *Entity Set Name* corresponding to the Entity Set for assigned Entity Class.
3. Each Entity Type Name **must** contain a reference to the *Object Type* of the Entity Type. This is normally through the use of AREA, POINT, SITE, LINE, or ARROW etc.
4. The Entity Type *Key Column* **must** be unique, be > 0, and may **never** be changed. These *Key Columns* may never be reused. If an Entity Types is deleted, that *Key Column* number is retired.
5. Each *Entity Type Name* **must** be unique**.**
6. Each Entity Type **must** contain a reference to the corresponding *Object Type*; e.g. G/GT Polygon, String/Chain, Point, Point/Polygon, or Arrow.
7. Each Entity Type **must** contain a reference to the coverages associated with the *Object Type*.
8. Each Entity Type Coverage Name **must** be unique**.**
9. Each Entity Type **must** have coverage names based on type in accordance with [G/GT Polygon] - *Polygon Coverage*, [String/Chain] - *Line Coverage*, [Point] - *Point Coverage*, [Point/Polygon] - *Polygon Coverage* and *Point Coverage*.
10. If an Entity Type references an Attribute Table in *Table Name*, it **must** be a valid, graphic Attribute table.
11. An Entity Type **must** reference the same *Table Name* as any related Entity.
12. If an Entity Type references a discriminating *Domain Table*, it **must** contain a *Discriminator Name*, which is an attribute coded as a Discriminator in the referenced Attribute *Table Name*.

Entities - - - -

1. Each Entity **must** reference a valid *Entity Type Name*.
2. Each Entity **must** reference the *Entity Class Name* referenced by it's Entity Type.
3. Each *Entity Name* **must** begin with the Abbreviations for the Entity Set and Entity Class; e.g. the Entity Class *Map Prefix*.
4. Each Entity Name **must** end in '_b', '_c', '_l', '_p', '_a', or '_t', based on the corresponding *Element Type*.
5. Each Entity *Key Column* **must** be unique**,** be > 0, and may **never** be changed. These *Key Columns* may never be reused. If an Entity is deleted, that *Key Column* number is retired.
6. Each Entity Name **must** be unique.
7. Each Entity *Alphabetic Code* **must** be unique and be 10 Characters in length**.**
8. Each Entity *Alphabetic Code* **must** begin with the corresponding code for the Entity Set and Entity Class; e.g. the Entity Class *Map Prefix* and end with the letter corresponding to the *Element Type*.
9. Each non-Text Entity (P, L, B, C) should have a *Level or Layer* which is unique within its Entity Class.
10. The Text Entities (A and T) for a given feature should share a common *Level or Layer*.
11. Each Entity *Discriminator Value* **must** be either "N/A" or a value from the corresponding discriminator Domain Table.
12. If the Entity has a *Discriminator Value* other than "N/A", the referenced Entity Type must contain a reference to a Domain containing that *VALUE.*
13. If the referenced Entity Type does not contain a Domain reference, the *Discriminator Value* **must** be "N/A".
14. If an Entity of *Element Type* "L", "C", "P", or "A", it **must** reference the same *Table Name* as the corresponding Entity Type.
15. Each Entity **must** contain a *Position* code based on [1] for boundary '_b' entities, [2] for linear '_l' entities, [3] for point '_p' entities, [4] for centroid '_c' entities, [5] for annotation '_a' entities, and [6] for text '_t' entities.
16. Each Entity of *Element Type* A **must** contain a four character Annotation Prefix ending in *. These must be unique within a Coverage; e.g. within a set of Entities referenced by a single Entity Type.
17. Each Entity **must** reference a valid SDS *Color.*
18. Each Entity of *Element Type* 'P' **must** be *Line Width* 4.
19. Each Entity of *Element Type* 'B' or 'L' **must** reference a valid SDS *Line Type*.
20. Each Entity of *Element Type* "A" or "T" or "P" must reference a SDS *Line Type* "0".

Features - - - -

1. Each Feature **must** reference a valid *Entity Type Name*.
2. The *Discriminator* **must** reference either a valid Entity *Discriminator Value* or contain 'N/A'.
3. If a *Feature Alias* refers to more than one Entity Type/Discriminator combination, it **must** contain a *Modifier*.
4. If an Entity Type has a discriminator, the Features associated with that Entity Type **must** reference all of the individual discriminators.
5. Each *Modifier* **must** be unique within the referring *Feature Alias*
6. The Feature Master *Occurrences* **must** indicate the number of times a particular *Feature Alias* appears in the Feature Table..

Tables - - - -

1. Each Table **must** reference a valid *Entity Class Name*
2. Each *Table Name* **must** begin with the applicable Entity Set and Entity Class Code; e.g. the *Map Prefix*.
3. Each *Table Name* **must** contain either 7 or 8 characters and **must** be unique.

4. Each Table **must** have a *Common Name* and they **must** be unique
5. Each Table **must** contain at least 3 Attributes. These are the Primary Key, a USER FLAG, and a META_ID.
6. A Table Name may be changed. However, the original *Table Name* may **never** be reused.
7. Each Table Key Column **must** be unique, be > 0, and may **never** be changed. These *Key Columns* may never be reused. If a Table is deleted, that *Key Column* is retired.
8. If a Table is a Graphic table; i.e. *Table Type* = 16, it **must** contain DATALINK as the first attribute.
9. If a Table is referenced in an Entity/Entity Type, is **must** be a Graphic table; i.e *Table Type* = 16.
10. If a Table is not referenced in an Entity/Entity Type, is **must** be a Non-Graphic table; i.e. TABLE TYPE = 64.
11. For a Non-Graphic table, the Primary Key **must** be the first (Position #2) attribute in the table. For a Graphic table, the Primary Key **must** be the second (Position #2) attribute in the table.
12. If a *Table Type* is Non-Graphic, it **must** be in a FMS Entity Class.
13. If a *Table Type* is Graphic, it **must** be in a SDS Entity Class.

Attributes - - - -

1. Each Attribute **must** reference a valid *Table Name*.
2. Each Attribute Name **must** be unique within any given Table and have a maximum of 10 characters.
3. Each Attribute **must** contain a unique *Position* within a Table, which, once assigned, may **never** be reused and cannot be changed.
4. Each Attribute **must** have a Data Type which must be "C"(Character), "M" (Unstructured Memo Text), "S" (Short Integer), "D" (Double Precision), "I" (Integer/Long Integer), or "R" (Real/Single Precision).
5. Each Primary Key **must** end in "_id" and have a minimum *Character Length* 20 if it is of *Data Type* "C". If it is an numeric, it **must** be *Data Type* "I".
6. Each Attribute that is a Foreign Key **must** end with "_id". If at all possible, the first occurrence of a foreign key within the table should precisely match the Primary Key name of the table to which the Foreign Key joins. "_id" Attributes **must** be *Data Type* "C" and *Character Length* matching the Primary Key to which it joins. with the exception of "map_id".
7. Each Attribute with a *Data Type* of "M" (Unstructured Memo Text) **must** have a NULL *Character Length*.
8. Each Graphic Table **must** contain a "map_id" attribute which **must** be *Data Type* "I".
9. Each Attribute ending in "_d" **must** be *Data Type* "C" and *Character Length* 16 or one of the numeric *Data Types* "S", "D", "I", or "R".
10. Each Attribute ending in "_d" **must** reference a valid *Domain Name*, *Domain Table*, and *Domain Number*. The *Domain Number* and *Domain Name* shall be consistent with the name and number which appears in **DOMAINS** for that *Domain Table*.
11. Each Attribute ending in "_d" which is coded as being a numeric **must** reference a valid **RANGE DOMAIN**.
12. Each Attribute ending in "_d" which is coded as *Data Type* "C" **must** reference a valid **LIST DOMAIN**.
13. Each Attribute ending in "_d" which is coded as *Data Type* "C" **must** either be a *Character Length* 16 or be coded as a *Source* [DISA][NIMA]
14. If an Attribute is a unit of measure attribute, is **must** end with "_u_d" and reference the *Domain Table* d_uom.
15. An Attribute **may not** be added to a any table with a position less than the highest position in that table.
16. If an Attribute is of *Data Type* "C", it **must** contain a positive *Character Length*.
17. If an Attribute is a date Attribute, it **must** be a *Data Type* "I" and **must** have a *Character Length* of 1

18. If an Attribute is a date Attribute, the definition **must** end with the statement "Format for date is YYYYMMDD (i.e., September 15, 1994 = 19940915)."
19. If an Attribute is a time Attribute, it **must** be a *Data Type* "I" and **must** have a *Character Length* of 2.
20. If an Attribute it a time Attribute, the definition **must** end with the statement "Format for time of day is HHMMSS. Use the standard 24 hour clock."
21. If as Attribute is defined as FMS, it **must** be in a FMS table and **must not** be in a SDS table.
22. Each Attribute **must** contain a *Common Name* and this *Common Name* **must** end in a designated DISA Identifying word
23. Each Primary Key *Common Name* **must** be "PRIMARY KEY IDENTIFIER
24. Each Foreign Key *Common Name* **must** be "FOREIGN KEY JOIN to " and the Table Name. In cases where this would result in duplications within a given table, a descriptive word(s) may be added in parenthesis at the end of The *COMMON NAME* such as (OWNER), (INPUT), (OUTLET), etc
25. Each Attribute *Common Name* **must be unique** within a given table.

Domains - - - -

1. Each *Domain Name* **must be UNIQUE** and may not contain special characters or spaces. The "_" character is permitted in lieu of a space.
2. Each Domain *Table Name* **must be UNIQUE** and begin with "d_".
3. Each Domain *Key Column* **must be UNIQUE** and be >0. These *Key Columns* may never be reused. If a Table is deleted, that *Key Column* is retired.
4. Each *Domain Type* **must** be either "R" for a Range Domain or "L" for List Domains.
5. Each *Domain Name* **must** be referenced by at least one Attribute.

List Domains - - - -

1. Each List Domain **must** reference a valid *Domain Name.*
2. Each List Domain *Full Value* **must be UNIQUE** within a given domain.
3. Each List Domain *Value* **must be UNIQUE** within a given domain.
4. Each List Domain *Value* **must not** contain spaces or special characters and be 16 characters or less.
5. Each domain which is not a discriminator domain **must** contain the values of "UNKNOWN", "TBD", and "OTHER".
6. Each domain value **must** match a *Discriminator Value* in the Entities table.
7. The *Key Column* and *Domain Name* referenced in List Domains **must** match the corresponding *Key Column* and *Domain Name* in Domains.

Range Domains - - - -

1. Each Range Domain **must** reference a valid *Domain Name*.
2. Each Range Domain *Max Value* **must** be greater than the *Min Value.*
3. Each Range Domain *key column* **must be UNIQUE** and be > 0. These *Key Columns* may never be reused. If a Range Domain is deleted, that *Key Column* is retired.
4. The *Key Column* and *Domain Name* referenced in Range Domains **must** match the corresponding *Key Column* and *Domain Name* in Domains.

Joins Relations - - - -

1. Each Join Relations *Key Column* **must be UNIQUE** and be > 0. These *key columns* may never be reused. If a Join Relations is deleted, that *Key Column* is retired.
2. Each Join Relations *First Attribute Name* **must** match the Primary Key of the *First Table Name*.
3. Each Join Relations *Second Attribute Name* **must** match a Foreign Key of the *Second Table Name*.

4. Each *Relationship* **must** equal the *First Table Name* . *First Attribute Name* = *Second Table Name* . *Second Attribute Name*.
5. Each *First Attribute Name* **must** equal the *Second Attribute Name*, except in cases where their are multiple Foreign Key links to the same table.